

# ALPINE CHAPTER

3<sup>rd</sup> Alpine Chapter Symposium, November 4<sup>th</sup> 2017

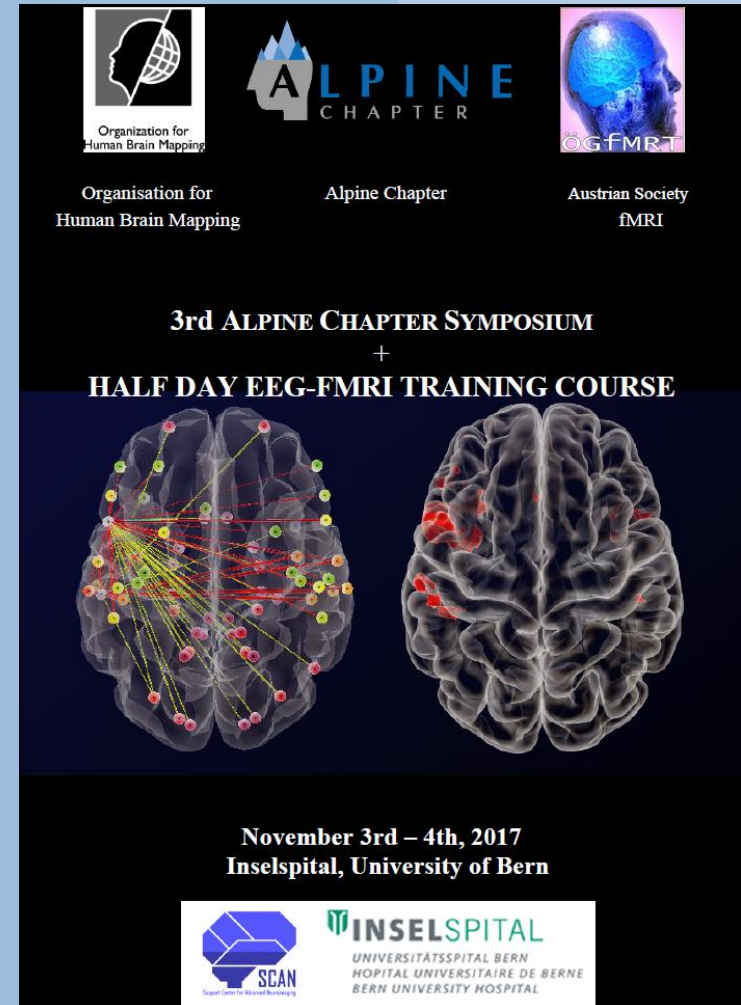
## Unexpected CBF response to anxiety reinforcing transcranial direct current stimulation

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Organization for Human Brain Mapping

ALPINE CHAPTER

Austrian Society fMRI

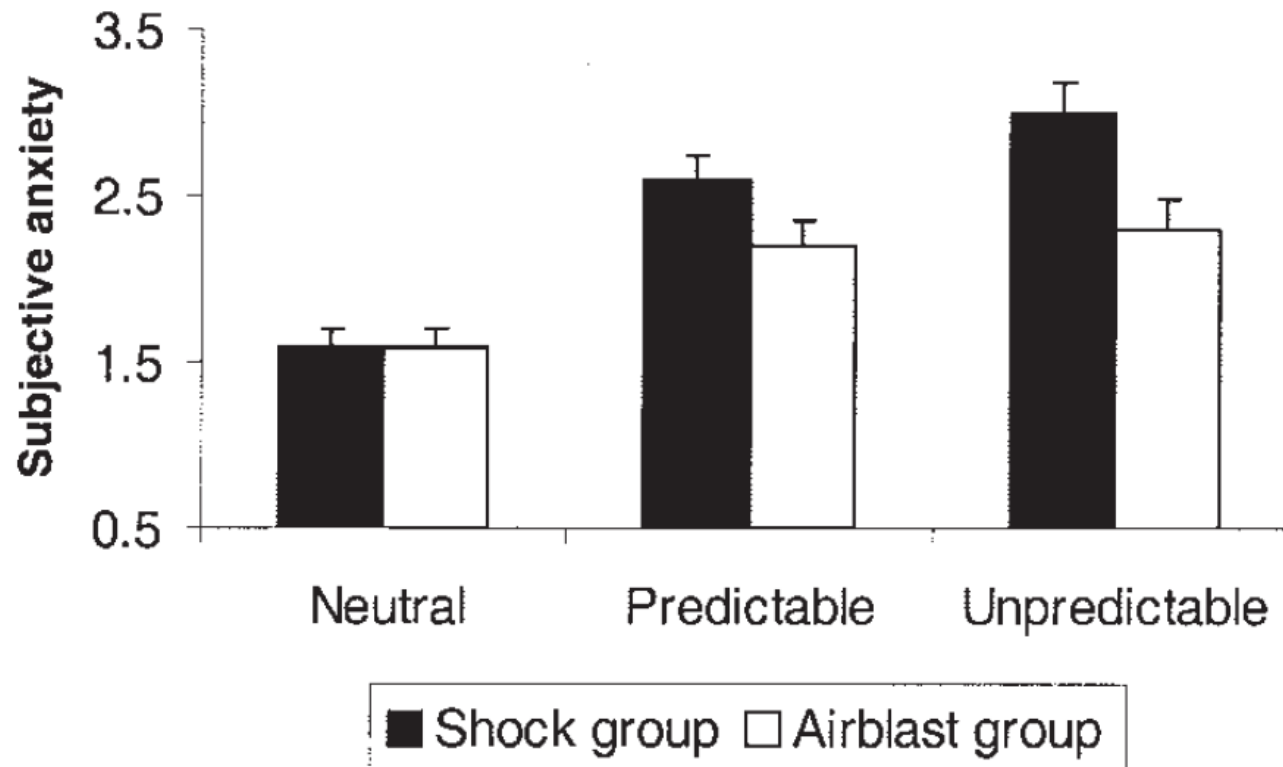
3<sup>rd</sup> ALPINE CHAPTER SYMPOSIUM  
+  
HALF DAY EEG-FMRI TRAINING COURSE

November 3<sup>rd</sup> – 4<sup>th</sup>, 2017  
Inselspital, University of Bern

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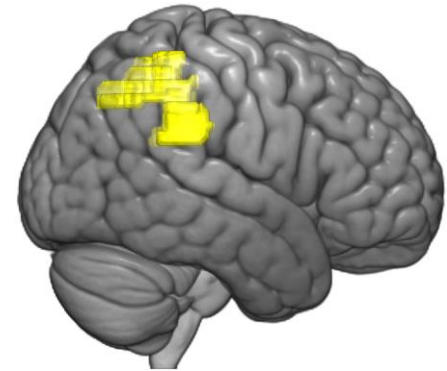
## Background: **anxiety vs. fear**



Grillon et al. (2004), *Behav Neurosci*

## Background: **Rationale**

- > Sustained anxiety is a key symptom of anxiety disorders.
- > Anxiety magnitude is negatively correlated to the activation in the right inferior parietal lobe (rIPL).
  - Particularly under the threat of an unpredictable shock, but not under neutral or predictable shock conditions (Hasler et al. 2007, *J Neurosci*).



## Background: **Aim of study**

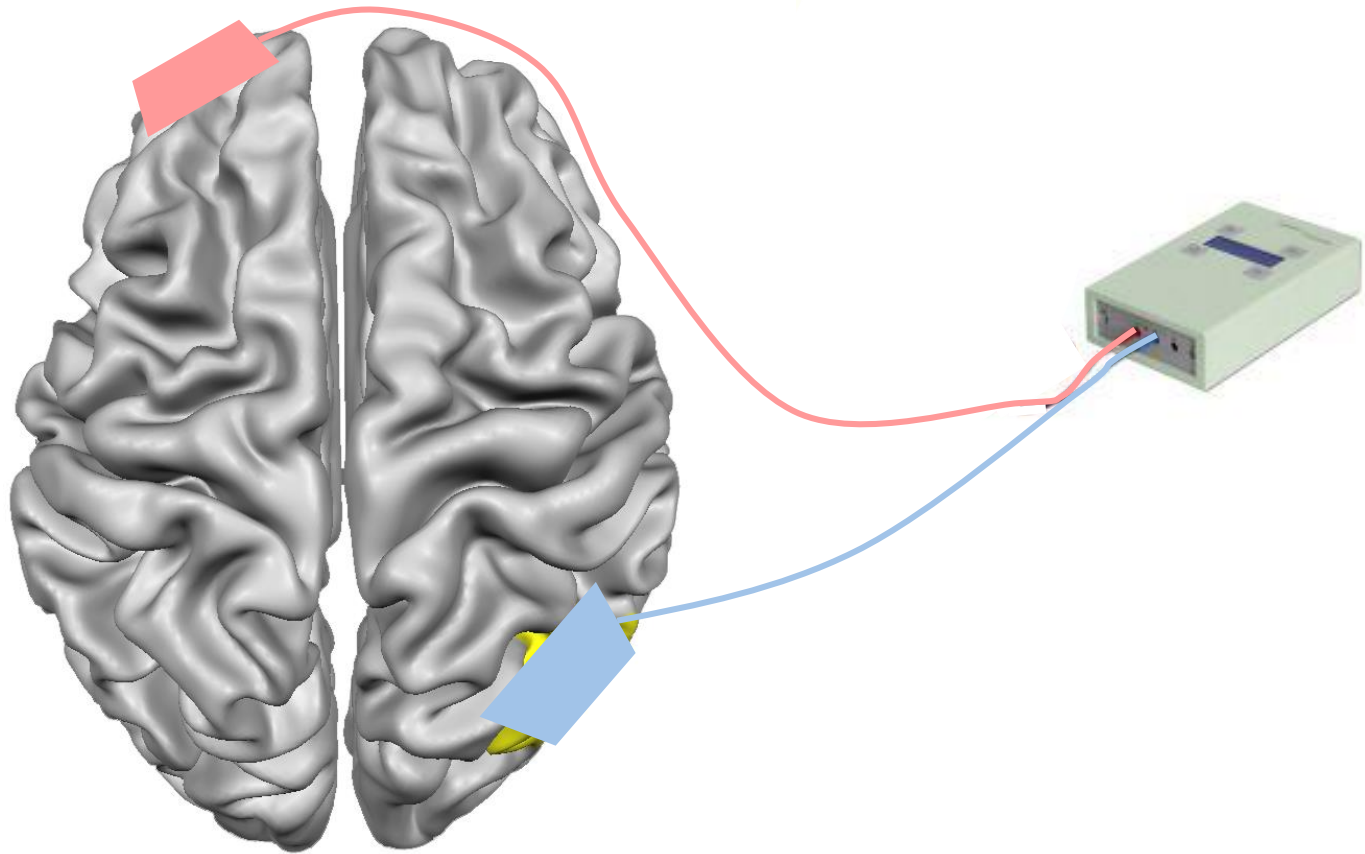
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- > Causal role of right inferior parietal lobe on anxiety

## Background: **region of interest – rIPL**

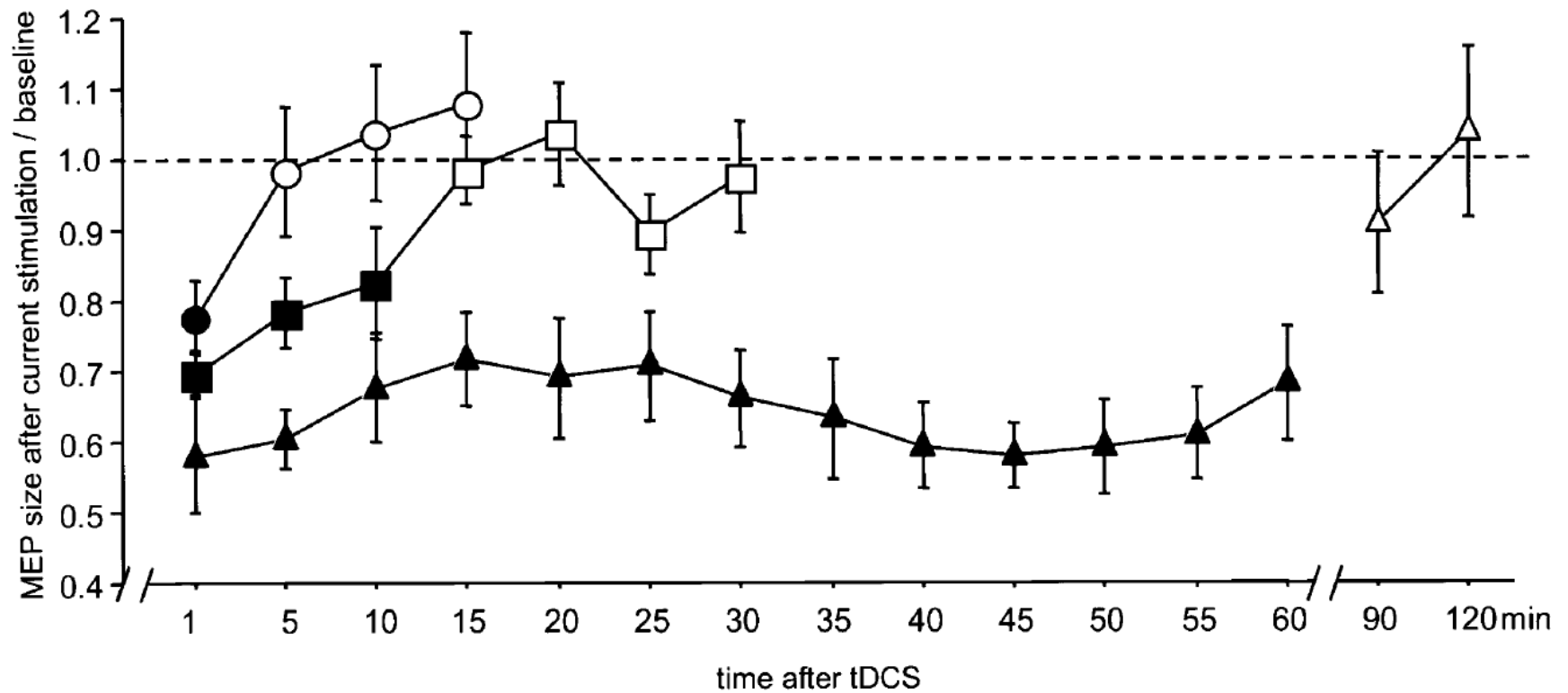
- > Lower CBF in anxiety (Kimbrell et al. 1999, Biol Psychiatr)
- > Resilience factor of stress in unpredictable threat situations  
(Hasler et al. 2007, J Neurosci)
- > Decision making in ambiguous situations (Huettel et al. 2006, Neuron)
- > Spatial attention and distractibility (Small et al. 2003, NeuroImage)

## Methods: tDCS setup



## Background: tDCS




- Cathodal tDCS → decrease of cortical excitability



Nitsche et al. (2003), *Clin Neurophysiol*

# Methods: anxiety-inducing task

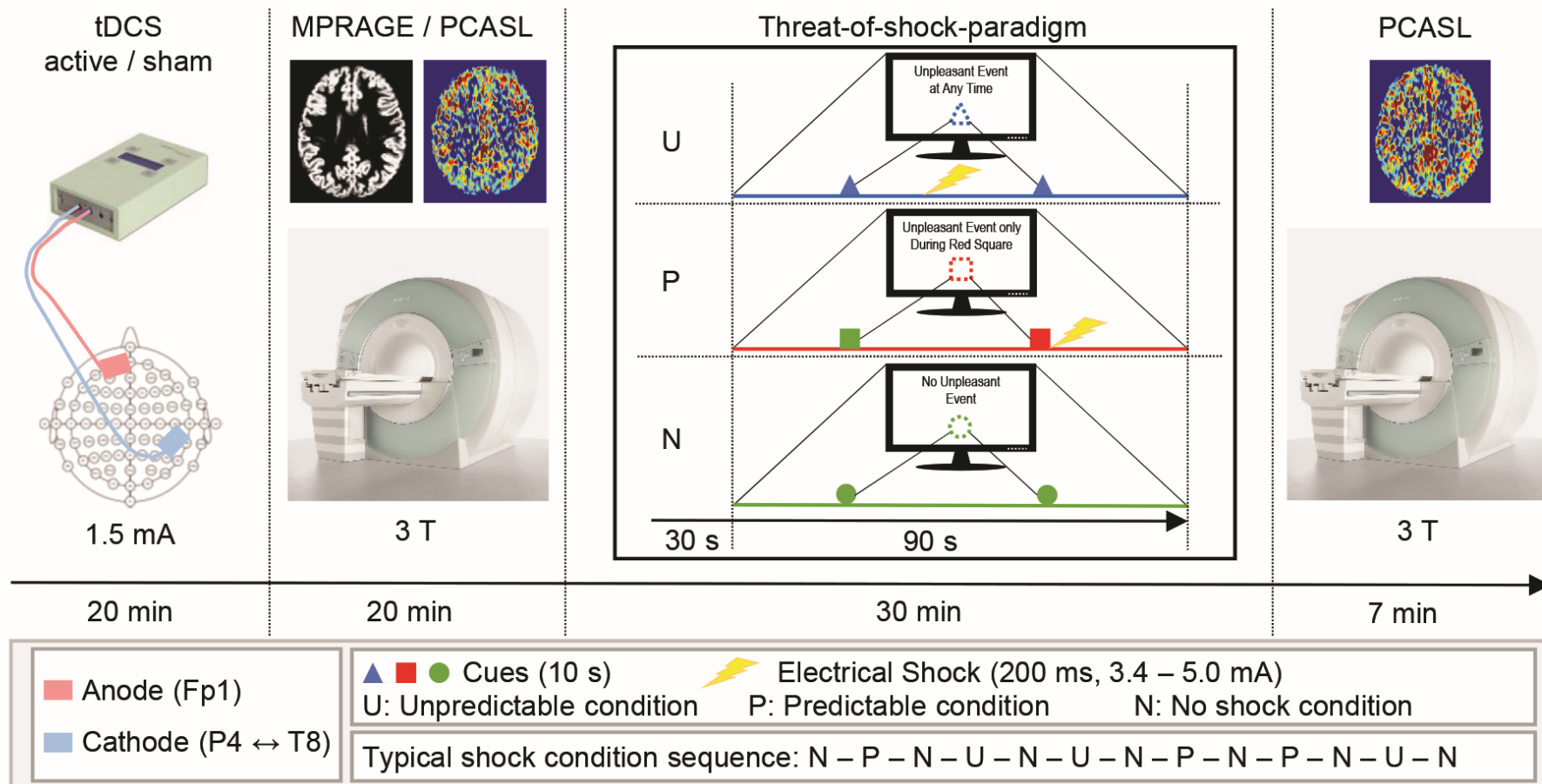
## > Threat-of-shock-paradigm

	No cue	Cue
N condition	No shock	No shock 
P condition	Shock only during red square	Shock only during red square 
U condition	Shock at any time	Shock at any time 

Schmitz & Grillon (2012), *Nat Protoc*



# Methods: Experimental procedure



Grieder et al. (in prep.)

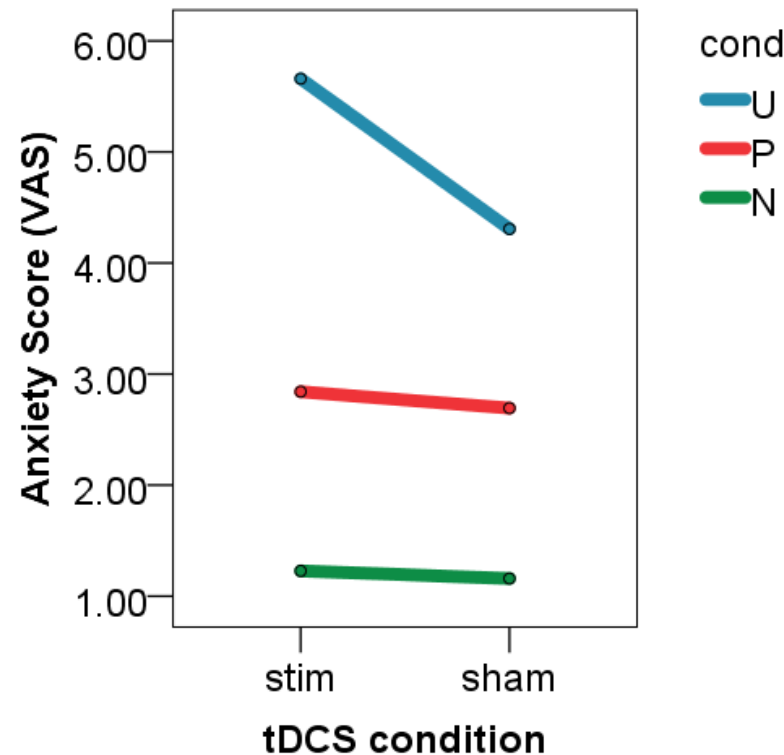
# Hypotheses

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- > tDCS reduces cerebral blood flow in the rIPL (Zheng et al. 2011, *NeuroImage*).
- > tDCS increases anxiety levels relative to sham tDCS, in the unpredictable threat condition (Hasler et al. 2007, *J Neurosci*; Nitsche et al. 2003, *Clin Neurophysiol*).
- > Possible effect of tDCS on the CBF time course in neuronal networks that are either hyperactive or hypoactive in anxiety disorders (Jensen et al. 2003, *Neuron*; Etkin & Wager 2007, *Am J Psychiatr*).

## Results: Anxiety

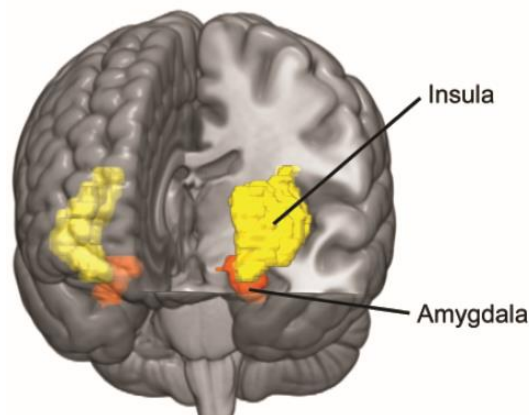
- > anxiety levels:  $U > P > N$  ( $F = 207.15$ ,  $p < 0.001$ , partial  $\eta^2 = 0.91$ )
- > tDCS augmented anxiety only in U ( $F = 27.6$ ,  $p < 0.001$ , partial  $\eta^2 = 0.57$ )



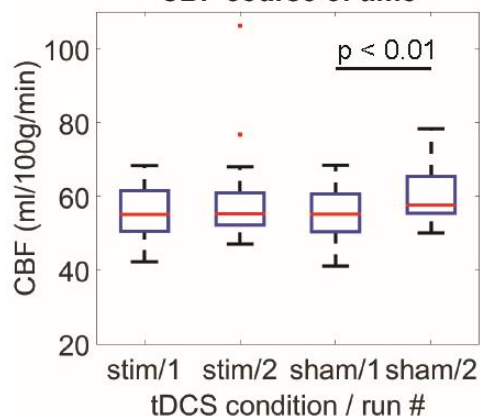
Grieder et al. (in prep.)

# Results: Cerebral Blood Flow

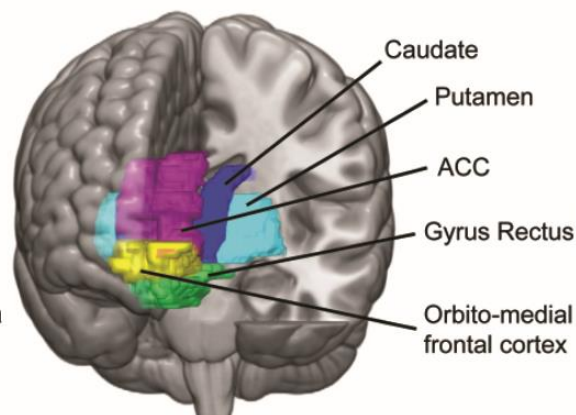
## Anxiety hyperactivation network



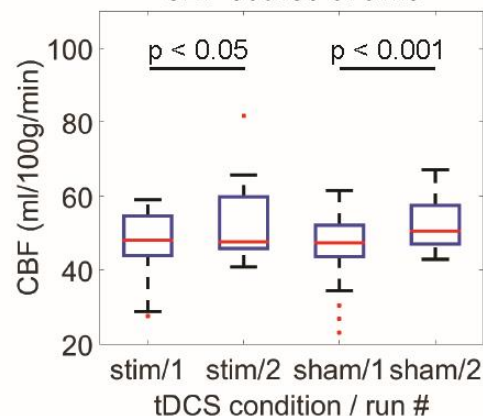
CBF course of time



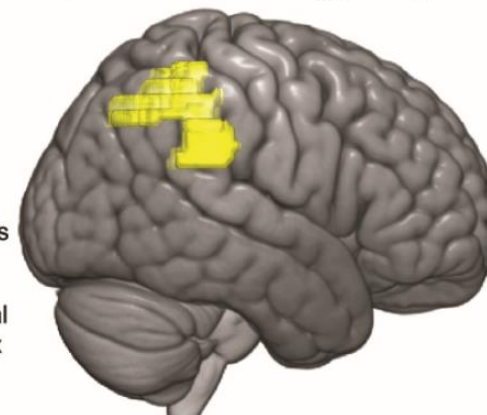
## Anxiety hypoactivation network



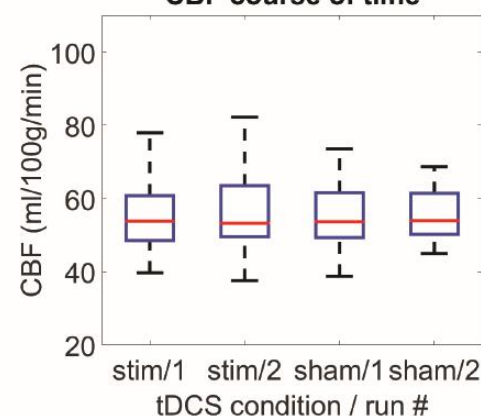
CBF course of time



## right IPL (cathode region)

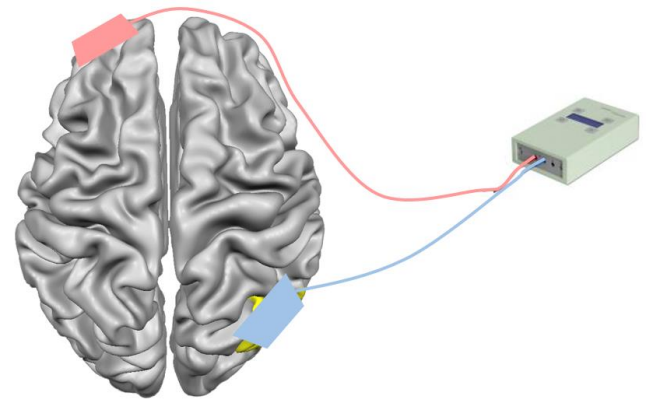


CBF course of time



## Discussion

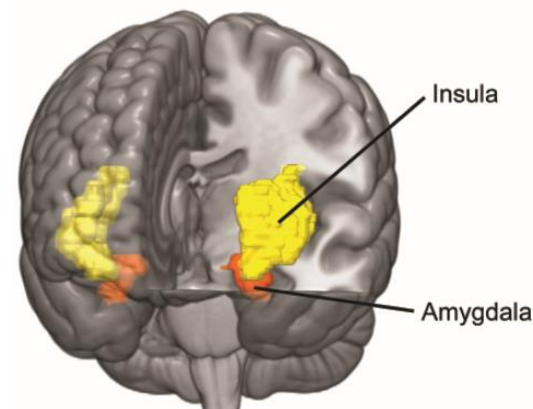
- > Right inferior parietal lobe **cathodal tDCS** **reinforces anxiety response** to unpredictable threat situations, but does **not alter cerebral blood flow in the same region.**
- > CBF-finding might have been influenced by anodal DLPFC stimulation



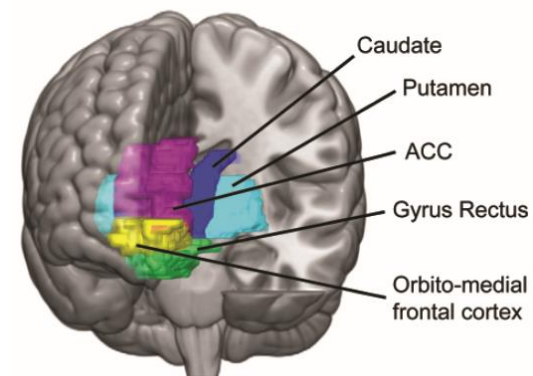
# Discussion

- > Reinforced anxiety due to a dysbalanced activation in neuronal networks related to sustained anxiety.
- > CBF-increase in hypoactivation network might reflect relief after concluding shock-paradigm (caudate & putamen as reward system, Jensen et al. 2003, *Neuron*)

## Anxiety hyperactivation network



## Anxiety hypoactivation network



# Acknowledgment



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